Written Testimony Submitted to the United States Senate Committee on Energy and Natural Resources

Testimony on Developing and Deploying Carbon Utilization Technologies

Submitted by Jason Begger, Managing Director, Wyoming Integrated Test Center, April 22, 2021

Chairman Manchin, Ranking Member Barrasso and members of the Committee, I appreciate the opportunity to speak to you today about our carbon technology efforts in Wyoming. My name is Jason Begger and I am the Managing Director of the Wyoming Integrated Test Center (ITC), which is a private/public partnership between the State of Wyoming, Basin Electric Power Cooperative, Tri-State Transmission and Generation Association and the National Rural Electric Cooperatives Association (NRECA). We have also received various in-kind contributions and support from Black Hills Energy and Rocky Mountain Power.

The ITC is a post-combustion, flue gas research facility located at Basin Electric's Dry Fork Power Station near Gillette, Wyoming. It the largest facility of its kind in the United States, delivering over 20 MW worth of scrubbed flue gas to researchers testing CCUS technologies. The power plant provides flue gas to six small research bays, each capable of hosting tests up to 0.4 MW and a large test bay that can host two demonstration projects with a cumulative total of 20 MW.

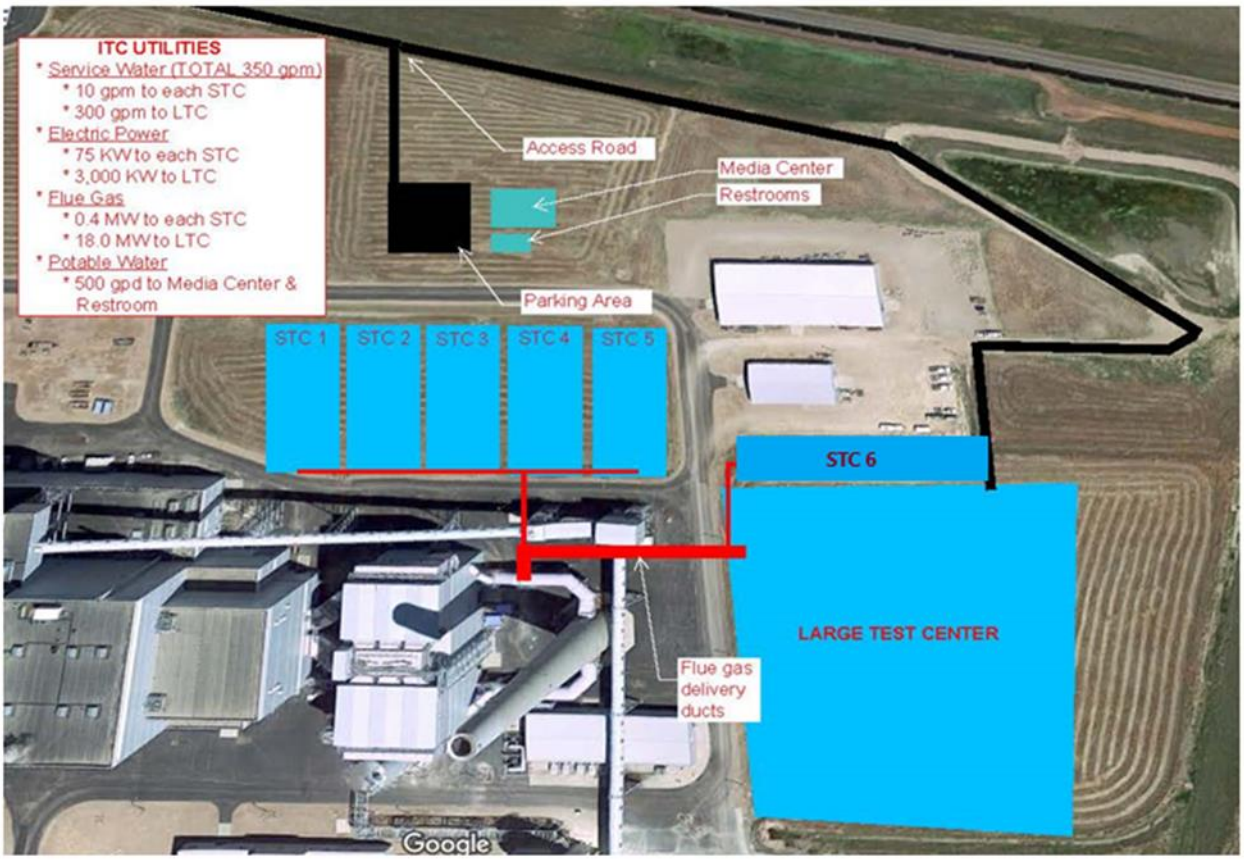

Fig. 1 – Site overview

To date, we have raised $21 million in funding, $15 million from the State of Wyoming, $5 million from Tri-State G&T, and $1 million from NRECA. While we believe there is an important role for the federal government to play in advancing technology and we would welcome such a partnership, not one cent of federal funding has been utilized in the costs of the facility, although some of our research tenants have received Department of Energy grants to conduct their projects on site.

Fig 2. – Small Test Bay tie-in

The State of Wyoming is the nation's largest coal producer, producing approximately 218 million tons in 2020. While this is still a significant amount of production, it is down from the peak in 2008 of 480 million tons. Given fossil energy's prominent role in the state, investment in carbon control technologies by Wyoming may seem unusual, but it all stems from an effort to move beyond the political rhetoric surrounding climate change science and focus on discovering technology solutions to ensure the long-term economic viability of Wyoming's fossil energy resources. It is important to remember that post combustion technologies are not just for coal plants, they can be utilized at natural gas facilities, cement plants and steel smelters. There is a significant need for these processes in non-energy applications.

The ITC is just one of several Wyoming programs aimed at commercializing next generation energy technologies. The University of Wyoming School of Energy Resources works on pre-commercial research; the Wyoming Pipeline Initiative is working to pre-permit corridors for CO2 pipelines; the Wyoming Enhanced Oil Recovery Institute researches the reservoir geology and is identifying carbon sinks for EOR opportunities and the Carbon Management Institute has active grants with the

Department of Energy to study permanent geologic sequestration. The Wyoming Energy Authority works to make the business case and integrate the various elements of diversified projects.

The one constant variable for all of these state entities is a push to commercialization. Every project needs to continuously track costs and economics, because without a demonstrable path to commercialization, all you have is an interesting idea. Strong partnerships with the private sector, especially those industries that would ultimately be a customer of the technology, helps ensure our research objectives are aligned with their economic needs. A great example of how this has been successful for Wyoming is the ITC Stakeholder Committee. This committee is comprised of representatives from major utilities who are involved in the technology evaluation processes for their various companies. These utilities are invaluable in determining the commercial appeal of a particular technology or process.

Fig. 3 – Overview of ITC connection to Dry Fork Station

CO2 management requires both the capture of CO2 and then permanently doing something with it to ensure it is not released into the atmosphere. The ITC is unique in that it has hosted both types of technologies. While work still needs to be done developing and commercializing capture technologies, we have seen commercial carbon capture projects on an array of industrial facilities across the globe. Today's commercial project largely utilize solvent technologies. Over the next few years, the ITC will be hosting research teams testing newer capture technologies such as dry sorbents and membranes with the goal of reducing capital construction and operational costs.

Wyoming has been utilizing CO2 for Enhanced Oil Recovery (EOR) for decades. EOR is particularly useful because it provides an economic incentive through the production of oil and just as important, it utilizes large quantities of CO2. The state is also home to a 10,000-foot test well under DOE's CarbonSAFE program. There's great promise that this site, which is located less than ½ mile from the ITC, will be able to permanently sequester CO2 in the near future.

CO2 is a very simple molecule, consisting of one carbon and two oxygen atoms. The array of products that can be created from oxygen and carbon is almost limitless. Fuels, plastics, building materials and carbonates are all examples. The opportunities for managing or utilization of CO2 is expansive, however, the costs and opportunities can vary dramatically based upon how the CO2 is used. For things such as EOR, geologic sequestration, biofuels, and certain mineralization technologies, the CO2 rich flue gas can generally be used as is, it needs to be captured and compressed. Various other technologies can be much more expensive. CO2 itself is a very stable molecule, created by a double covalent bond that requires a lot of energy to break apart the atom, so for technologies requiring this, they will likely have high energy inputs and operational costs that will necessitate a high-value product to make the system economical.

Another consideration is the amount of CO2 being utilized. EOR, geologic sequestration, and mineralized CO2 to make aggregate and concrete could can utilize vast quantities of CO2. CO2 to products will use far smaller amounts and, in some cases, CO2 emissions far exceed global market demand for certain products. Nonetheless, all technologies are important, and we need all options available to successfully utilize large volumes of CO2.

At the ITC, we do have experience with CO2 utilization technologies. On Monday, the XPRIZE Foundation announced the winner of their five-year NRG COSIA Carbon XRPRIZE competition, which hosted the final round of the coal tract at the ITC. While COVID-19 travel restrictions prevented teams from China, India and Scotland from traveling to Wyoming, we did host two U.S. technologies studying concrete and chemical feedstocks. The ITC hosted the winner of the coal tract, CarbonBuilt, which utilizes CO2 in concrete production.

We also have a project in the works with Japan and Columbia University, which will look at a technology developed for the steel industry and examine its applicability at a coal plant. It will use CO2 from the plant and calcium from fly ash to produce calcium carbonates that can then has an array of industrial uses. One of the more interesting applications is making silica, which can be used to make polyciliate, which is a critical component of solar panels. Currently 80% of the global polyciliate supply comes from a region in China with serious human rights concerns. It is possible we could use CO2 from a coal plant to produce raw materials for the renewables industry.

If fully funded, the programs authorized in December will go a long way towards advancing the full array of carbon management technologies. However, we need to make sure we do not forget that we need the facilities necessary to conduct that research. The ITC is primed to host these projects and could take on a larger role with additional infrastructure.

While programmatic funding is extremely important, Congress also needs to provide the means to carry out these projects by supporting the places where this research can occur. NETL and the National Carbon Capture Center are great examples of places doing research, but the U.S. critically needs places to test at larger scales. For years the U.S. Department of Energy has been sending American developers

with U.S. taxpayer funded grants to Norway to test at the Mongstad test center because there was not a large enough test facility in this country. The ITC was constructed to fill that space, but still does not have all of the amenities the Norway facility can offer. We strongly believe that the ITC can fill an important role in commercializing CCUS technologies at a better value to the U.S. taxpayers with some additional investment. We have the perfect blank canvas, now we need to fill it.

Wyoming is the perfect place to conduct CCUS research. We have facilities, we have agencies with expertise in regulating CO2 and a "get to yes" attitude towards permitting, we have a legislature and governor supportive of technology development and lastly, we have public support for these types of projects. Within the last two years, Wyoming's budget has included over $25 million in funding to for CCUS research. If we are able to leverage those funds against DOE or other private sources, we have the ability to host some meaningful projects.

Fourteen years ago, Apple released the first iPhone which came with 4 GB of memory, a 2-megapixel camera, no flash, no zoom, and no video camera. Today's iPhone 12 Pro Max has up to 512 GB of storage, facial recognition, four 12-megapixel camera and HD video recording capabilities. Yes, today's CCUS technology is expensive and still evolving, but as we know, technology gets better and less expensive over time.

We need to begin to think about energy technology as we do with the items we use every day and recognize the important contributions early government support provided to make them reality. Touch screen glass, a staple of today's smart phones, was developed in the United Kingdom funded by the Royal Radar Establishment in the 1960's for use in air traffic control systems. GPS, canned food, microwave ovens, the internet, microchips, vaccines and nylon are items all developed by federal research.

Technology is apolitical and the U.S. can make its greatest impact by investing in technology development that can be utilized around the world. There is considerable debate over the future of coal within the United States. However, every credible energy analysis from the UN Intergovernmental Panel on Climate Change to DOE acknowledges large amounts of coal will be used globally for the foreseeable future. Technology is the best way to ensure these countries have access to power yet meet environmental goals.

I appreciate the opportunity to speak with you today and will gladly answer any questions. Thank you.